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MEMORANDUM FOR THE RECORD

SUBJECT: [REDACTED] Visit to NPIC on 14 January 1964.  
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1. Enclosed are [REDACTED] comments concerning the performance of the microscope and viewing conditions which he observed during his trip to NPIC.

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2. [REDACTED] submitted this memorandum during his visit to Headquarters on 25 February 1964.

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Executive Secretariat  
Scientific Advisory Board

2 March 1964

MEMORANDUM FOR THE RECORD

SUBJECT: Comments on Trip to NPIC, 14 January 1964.

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1. These are a part of my observations made at NPIC during my visit of 14 January 1964. I asked to see materials of the best quality. I was shown KH 4 [REDACTED] samples, including the resolution targets near Washington, D. C., and other samples from the flights that occurred over Washington on 26 December 1963, and a number of the other best photographs thus far achieved. My interest in the inspection of these materials was not so much in the materials themselves as it was in the performance of the microscope and the viewing conditions. It seems to me that the end product of the whole reconnaissance system is the light that enters the eye of the interpreter. It is his interpretation of what he is able to see that produces the final intelligence of value to our country, and I am not convinced that everything has been done to maximize his ability to extract the best possible retinal image from the pictures.

2. This is a natural interest of mine partly because I have, since World War II days, been a member of the Armed Forces-National Research Council Committee on Vision, and partly because all of my activities have been devoted exclusively to visibility matters for many years. I was interested, therefore, in looking at the microscope from the standpoint of the visual performance achieved with it and the viewing conditions under which the photo-interpreters presumably operate.

3. I endeavored to ask questions concerning the way in which the actual interpreters use the microscopes. I did not meet any of the interpreters or see them in the performance of their work. So far as I am aware, the interpreters use the same type of microscope and presumably work under the same sorts of conditions that I experienced during my visit on 14 January. From many things that have been said both in the various presentations I have heard and in the responses to the questions I have asked, I realize that the Agency is well aware of some of the shortcomings of the microscope and the viewing conditions under which it is used. For example: I recall from the briefings that studies have been made of means for increasing the apparent luminance of the diffusing surface against which transparencies are viewed. This is an important matter because, at high power, the exit pupil of the microscope is quite small and produces retinal illumination lower than is desirable in the darker portions of the scenes. I am convinced that any observer can obtain more information from the film at high power if more light could be made available. I am prepared to believe that the optical design of these constructions has been carefully considered and that a larger exit pupil is not practicable. If this is true, there seems to be little recourse except to increase the light available below the transparencies.

4. The performance of the observer can also be increased by improving the contrast rendition of the microscope. No one to whom I talked had any information concerning the contrast rendition of the system as now exists. My impression is that the system is far from being poor in this respect, but on the other hand, I would be surprised if worthwhile improvement could not be achieved rather easily. Quantitative measurements of contrast rendition which I have seen on other high quality microscopes indicates that improvement is almost always possible if a small opaque stop can be introduced at the transparency. In one installation with which I am familiar, a thin piece of metal containing a hole only large enough to allow the microscope to inspect the portion of the transparency corresponding to the field of view of the scope was provided in order to prevent light from other portions of the picture from reaching the microscopic

objective lens. It produced a very noticeable improvement in the apparent contrast of the photographs, particularly at high power. Such a result could be achieved automatically if illuminated diffusing glass beneath the transparency is replaced by a lamp housing from which light is emitted only by a small area directly beneath the microscopic objective.

5. In the present instrument the large illuminated diffusing glass produces a very distracting glare field into which the observer is forced to look. I understand that some operators make a practice of covering this illuminated area with opaque material, such as cardboard, in order to diminish this glare. I heartily endorse this practice and strongly urge its adoption and extension. I understand also that the interpreters tend to turn off the lights in the room while looking into the microscope. This also is a desirable practice. Unless both of these precautions are taken, the observer will be surrounded by enough room light to impair his visual performance unless well fitted eye cups are provided.

6. The small plastic shields with which the present instrument is provided are virtually useless and doubtless are seldom used. A dramatic improvement in visual performance can be effected simply by using ones hands to form eye cups before the microscope. The full improvement is not experienced until all of the stray light is excluded. I strongly recommend that the existing microscope be fitted with very good soft rubber eye cups. It would be desirable to have these specially made for each photo-interpreter so that he can achieve a comfortable, tight fit. If such cups are provided, the glare produced by the large illuminated diffusing glass will be negated, except for the deleterious effect arrising from abrupt changes in his adaptation which will occur when he lifts his eyes from the eye cups and looks at the brightly lightly lighted field beneath the microscope. Presumably it is necessary for him to do this at frequent intervals. Despite the fact that adaptation is a comparatively rapid process at high light levels, visual performance will be degraded for periods of several seconds after the eyes are returned to the eye cups if there is any form of glare source in the working environment. Glare-free viewing conditions in the work space outside the microscope eye-piece is highly desirable.

7. My visual inspection of the microscope made me believe that achromatigation conditions could be improved, particularly at high power. It is possible that some of the chromatic effects which I seemed to observe stem from the spectral distribution of the light from the illuminating system. It is possible that the spectral distribution of the light from the diffusing glass has a very different composition than that which was assumed by the lens designer who achromatized the microscope. This might be worth reviewing. In any event, reduction of chromatic effects in these microscopes could improve visual performance on the part of the photo-interpreters.

8. The microscopes eye pieces have focussing adjustments but these are not provided with diopter markings. The adjustments for interpupillary distance, moreover, do not appear to have a calibration scale. The photo-interpreter should not be expected to operate eye piece adjustments and make settings of interpupillary distance by trial and error. Just as in the case of military lookouts, his refractive correction and interpupillary distance should be determined carefully by clinical procedures, and he should set the diopter rings and the interpupillary adjustment in accordance with clinical findings before he attempts to look through the microscope. If the clinical work is done properly and if the microscope is properly adjusted and calibrated, the observer will have his eyes properly aligned with the optic axis of the instrument and provided with the optimum (spherical) correction. In no other way will he obtain the best visual performance of which the microscope is capable.

9. The photo-interpreters should not wear spectacles while looking through the microscope. These will not be necessary unless he is inflicted by astigmatism or some other visual defect for which ordinary eye piece focussing adjustments do not provide a correction. Each photo-interpreter should be given a very careful periodic ophthalmic examination. Provisions should be made in the microscope for introducing cylinders (and prisms and if needed), tailored to the prescription of each man. Spectacles will then not be necessary.

10. I wish particularly to emphasize the loss in visual acuity in the use of microscopes such as those now employed by the Agency if the observer has uncorrected astigmatism, even astigmatic defects so slight as ordinarily to be considered as sub-clinical. These can quite demonstratively impair his visual performance.

11. The effect of small amounts of the astigmatism can be quite insidious, because the interpreter is ordinarily looking at non-sharp images and must endeavor to discriminate fine details buried in soft or grainy photographic images. He has no way to know whether the unresolved image he sees is truly representative of the film or whether part of the apparent loss of resolution is created by astigmatic or other defects in his own eyes. He should not be asked to make this judgement; rather, he should be subjected to frequent, careful ophthalmic examinations and he should be provided with full corrections on each eye piece. In fact, I would strongly urge that the photo-interpreter on whose visual performance so much depends should have very careful special eye examinations not less frequently than once a month, primarily in order to detect small changes in astigmatism which may develop. Experience may indicate whether such tests should be done less frequently or more frequently than monthly, but clearly a testing program should be instituted by the Agency and should be mandatory and not left to the discretion of the individual photo-interpreter or his private ophthalmologist or optometrist. No detectable sub-clinical astigmatism should go uncorrected.

12. It would be desirable to give careful consideration to improving the comfort of the photo-interpreter while working through the microscope. Professional attention to such items as seats, arm rests, head rests, etc. should be given and these should be tailored to the stature and requirements of each photo-interpreter. The acoustical environment should also be considered and everything done to eliminate distraction, discomfort, and fatigue for these men.

13. Visual performance varies with age. I understand that the group of photo-interpreters used by the Agency contains a wide spectrum of age. The visual capabilities of the men should be considered and possibly measured. Critical materials might profitably be looked at by more than one individual, inasmuch as there maybe a trade-off between the effects of age on visual performance and interpretation capabilities.

14. Finally, a review might profitably be made of design compromises of the microscope, primarily if it affects their performance at high power. A different instrument with higher power capability might reveal more information in some instances than can be obtained with the present microscope. It was my impression that more power would have been helpful in a few instances.

15. A study might also be made of the color and the spectral distribution of the lighting. Small second order improvements might result from a change of lighting.

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Optics Panel  
Scientific Advisory Board